

Interim Progress Report to BEACON

October 2006

Santa Barbara and Ventura Counties Coastal Processes Study



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Coastal and Marine Geology Program
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Collaborating Agency: *University of California, Santa Cruz*
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Project Time Period: August 2005-December 2007

Project Objective: Identify and quantify the pathways for nearshore sediment transport in Santa Barbara and Ventura Counties, with emphasis on critical regions of shoreline erosion.

Project Approach: Conduct a regional study of the Santa Barbara-Ventura County coast, complemented with three localized studies in areas of critical interest. Work will be conducted with both state-of-the-art field and numerical modeling techniques.

Project Summary

The United States Geological Survey (USGS) and the University of California, Santa Cruz (UCSC) are collaborating on a two-year project to identify and quantify the pathways for nearshore sediment transport for the coast within Santa Barbara and Ventura Counties, California. Funding is scheduled to end December 2007. However, the USGS anticipates a moderate level of funding from an internal Multihazards Initiative to continue to support coastal vulnerability analysis. Work described in this project is supported by BEACON (Beach Erosion Authority for Clean Oceans and Nourishment), the City of Carpinteria, and the United States Geological Survey. The work is conducted in collaboration with United States Army Corps of Engineers (USACE), Los Angeles District.

The approach of the study has been regional, but with three areas chosen for focused, high resolution survey work:

- 1) Goleta/Isla Vista/Ellwood
- 2) Carpinteria
- 3) Ventura/Santa Clara River mouths

Work Completed and Planned

We will be addressing each of the tasks as outlined in the accepted proposal of August 2005, which was designed to respond directly to the USACE Project Management Plan (PMP) for the region:

Coast of California Storm and Tidal Waves Study (CCSTWS) Ventura/Santa Barbara Counties, California PMP (April 2004)

Task 1. Surveys and Mapping

1a. Beach Profile Surveys

In October 2005, the Bureau of Economic Geology (BEG) of the University of Texas at Austin, flew a coastal lidar (light detection and ranging) survey along the 150 km stretch of coastline from Point Conception (Latitude N34° 27', Longitude W120° 27') to Point Mugu (Latitude N34° 5', Longitude W119° 3') (Figs. 1-2). Along this region, the beach topography was mapped from the surf zone to the point landward of any foredunes, bluffs or cliffs that bound the

upper extent of the beach. This survey was a collaborative effort between BEG, BEACON, California Department of Boating and Waterways, UCSC and USGS. Using these data, the USGS will grid the topographic points and extract subaerial profiles from the 25 established BEACON transects plus the additional 12 requested lines for comparison with the historical transects. We will also compare the 2005 lidar with the 1997 lidar survey of this stretch of coast to assess short-term coastal change rates.

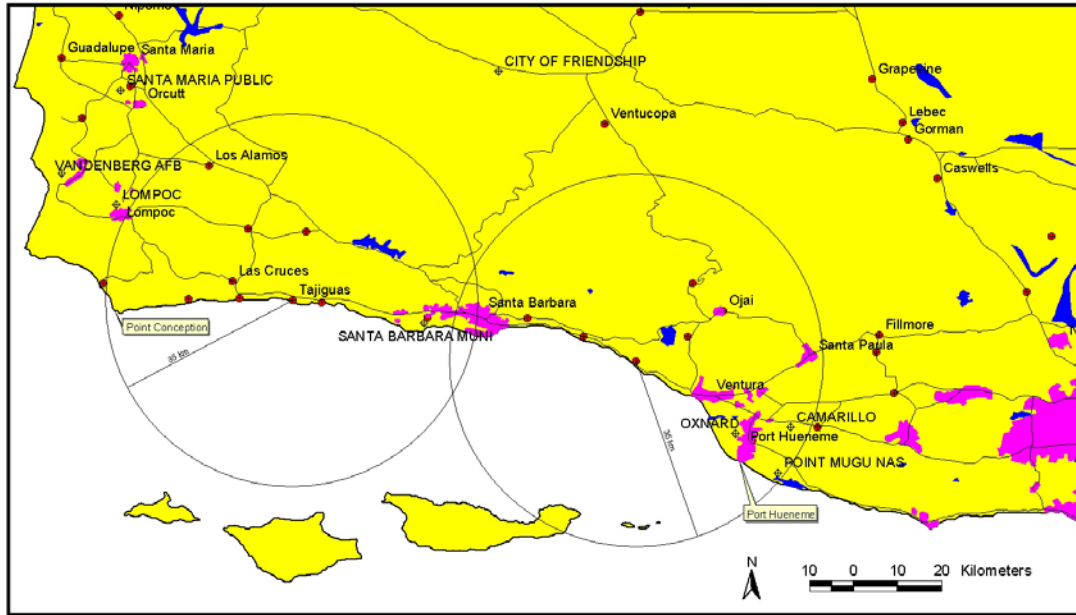


Figure 1. October 2005 lidar coverage area.

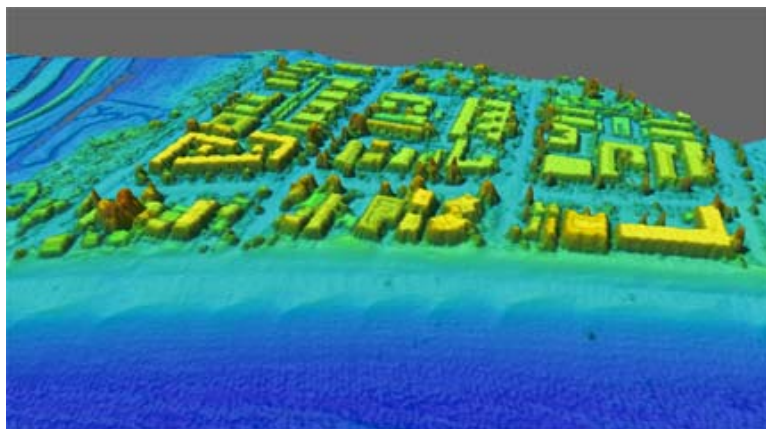


Figure 2. Example of topographic data extracted from the lidar survey. This image focuses on the city beach at Carpinteria, with Linden Ave. running top to bottom (north to south) on the right hand side of the image.

Using all-terrain vehicles (ATVs), topographic surveys of the beach surface were collected at the three focus study areas in October 2005 and March 2006 (Fig. 3). These surveys, conducted with differential GPS (DGPS- accuracy ~2 cm horizontal and vertical), are being used to monitor seasonal beach changes and assess lidar accuracy. Additional survey sets are planned for October 2006 and March 2007.



Figure 3. Surveying the beach with DGPS in Carpinteria.

The USGS used a Real Time Kinematic Differential Global Positioning System (RTK-DGPS) mounted on a personal watercraft (PWC) to collect bathymetric horizontal and vertical position data in the study area. At this time, two full surveys have been completed in the focus areas of Goleta, Carpinteria, and Ventura; one in the fall of 2005 and a second in the spring of 2006. In 2006, additional DGPS data were collected in Rincon, which is not in RTK because of monument access limitations, but can be post-corrected to a final product of similar data quality. This dataset consists of over 300 cross-shore and alongshore profiles in water depths ranging from 15 m to 1 m at inshore locations. These surveys show very little seasonal change from October to March, on the order of 1 m of erosion or accretion at a maximum. Figure 4 displays surveyed lines in March 2006 and the resulting grid from these lines. Figure 5 shows an example of change between 2005 and 2006 for one line from each subcell. The profiles are plotted along the line since they are not constant in northing or easting, so the x-axis represents distance along the line in meters.

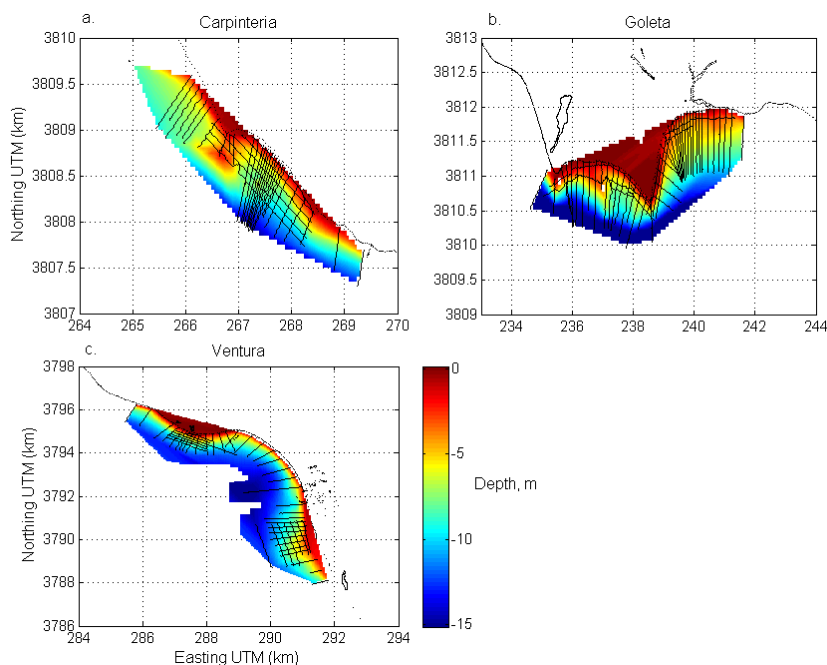


Figure 4. PWC survey lines and gridded data for March 2006 in a) Carpinteria b) Goleta and c) Ventura.

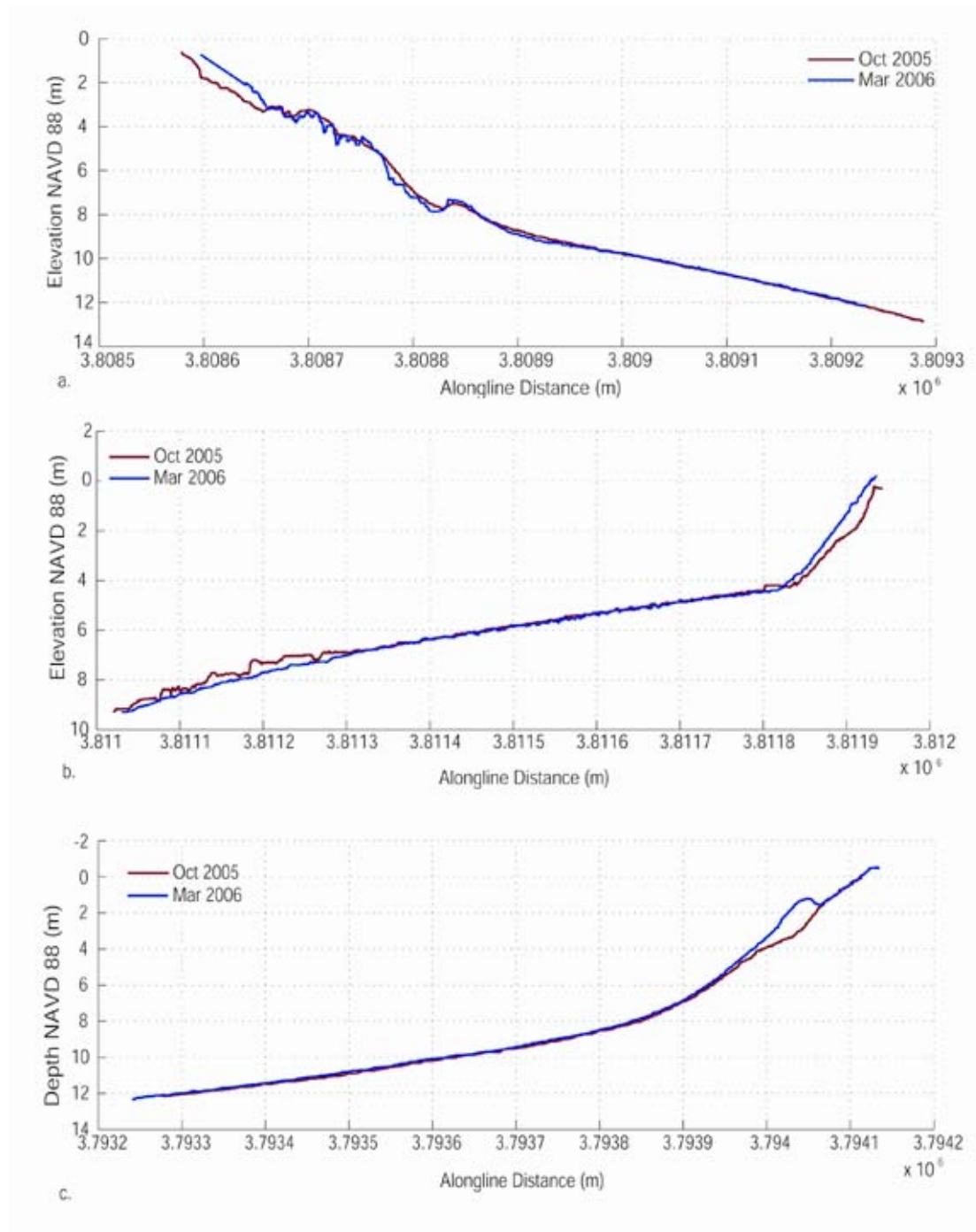


Figure 5. Comparison of seasonal change in individual profiles for a) Carpinteria Line 8 b) Goleta Line 10 and c) Ventura Line 20.

1b. GIS Integrations

All prior survey data from the data mining along with the data to be gathered in this project are being integrated into a GIS database of the entire Santa Barbara/Ventura region. The USGS/UCSC researchers will continue to work directly with USACE and BEACON to ensure compatible GIS formats and structures.

Task 2. Coastal Studies Report

2a. Data Collection and Review

Extensive data mining has been conducted over the first year of the study, and will continue until completion. All data pertinent to the study objectives will be reviewed with respect to the scope of the field investigations. Heather Schlosser at the USACE has been especially helpful in acquiring reports for our review.

2b. Sediment Source, Sink and Entrapment Investigations

High resolution multibeam and side scan bathymetric mapping has been conducted in the three focus study areas: Goleta, Carpinteria, and Ventura/Santa Clara River areas (Fig. 6). In addition, the USGS successfully lobbied the California Coastal Conservancy for an additional \$400,000 for multibeam mapping to complete a nearshore bathymetric map between the State of California 3 mile limit and the surf zone, stretching from Pt. Mugu to Point Conception. Thus far, the nearshore strip between Pt. Mugu and Rincon Parkway has been completed. In summer 2007, it is anticipated that the mapping will extend west of Goleta (Fig. 7).

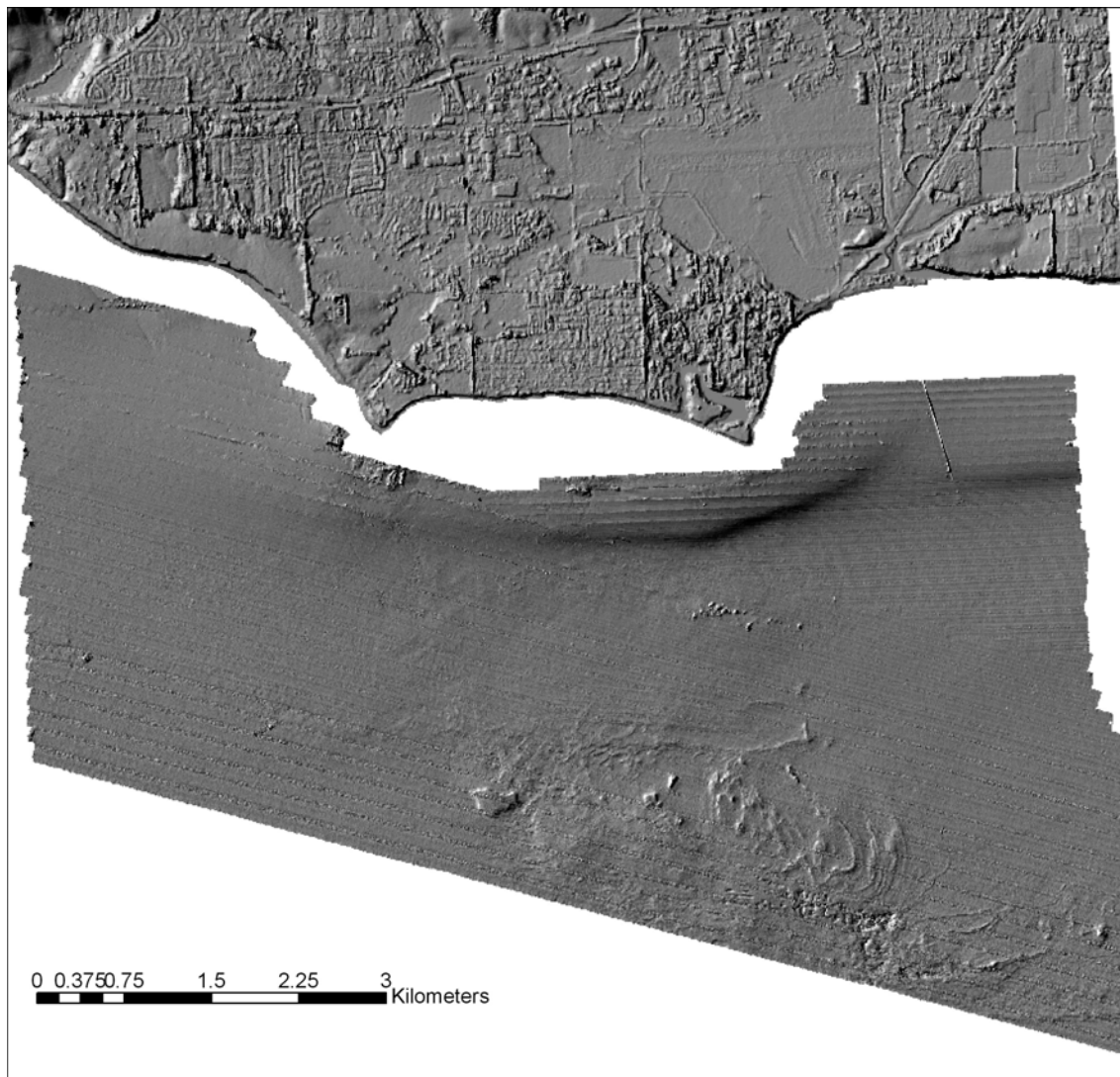


Figure 6. Shaded relief image of multibeam sonar data collected offshore of Goleta in July 2006.

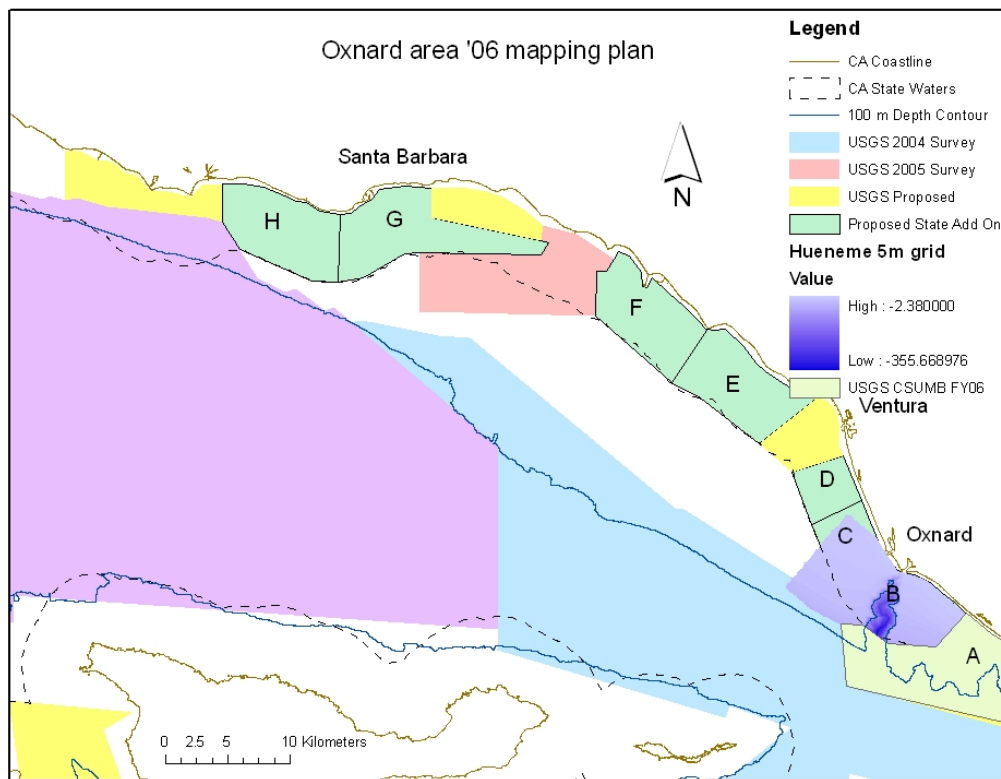


Figure 7. Multibeam coverage areas. Areas in yellow were completed by the USGS in summer 2006. As part of a Coastal Conservancy grant, areas A-E were completed in summer 2006, and F-H and points west are scheduled for summer 2007.

David Revell's dissertation will summarize historical changes in shoreline and beach width. See task 2f for more information.

Swash, mid-beach and backbeach digital Beachball© samples and grab samples have been collected throughout the littoral cell (Fig. 8). During July 2006 beach samples were collected at 94 locations from Gaviota to Pt. Dume. Except for large gaps due to limited access, sample locations were approximately one kilometer apart. To address seasonal grain size concerns, the beaches of the high resolution study areas (Ventura, Carpinteria and Goleta/Isla Vista) have been sampled during both summer and winter conditions. Images are now being processed for mean grain size.

In August, the Flying Eyeball© was used to collect sediment samples from the nearshore at 5, 10 and 20 meter water depths (Figs. 8-9). Video samples were collected every kilometer between Isla Vista and Oxnard. In addition, samples were collected every 5 kilometers and 2 kilometers in the northwestern and southern portions of the cell. Grab samples were also collected at various depths and locations throughout the cell. Images have been extracted from the video and are now being processed for mean grain size.

To analyze the digital images, from both the Beachball© and the Flying Eyeball©, sand from many locations has been combined into one bulk sample for each sampling system. This sediment was sieved and imaged. These images are now being processed to determine a calibration curve which will be used to determine the grain size of samples collected *in situ*.

Settling tube results from the grab samples are being used to check sample results. Once grain size has been determined, beach and nearshore sediment size will be mapped for the region.

Santa Barbara Littoral Cell Sediment Sample Locations

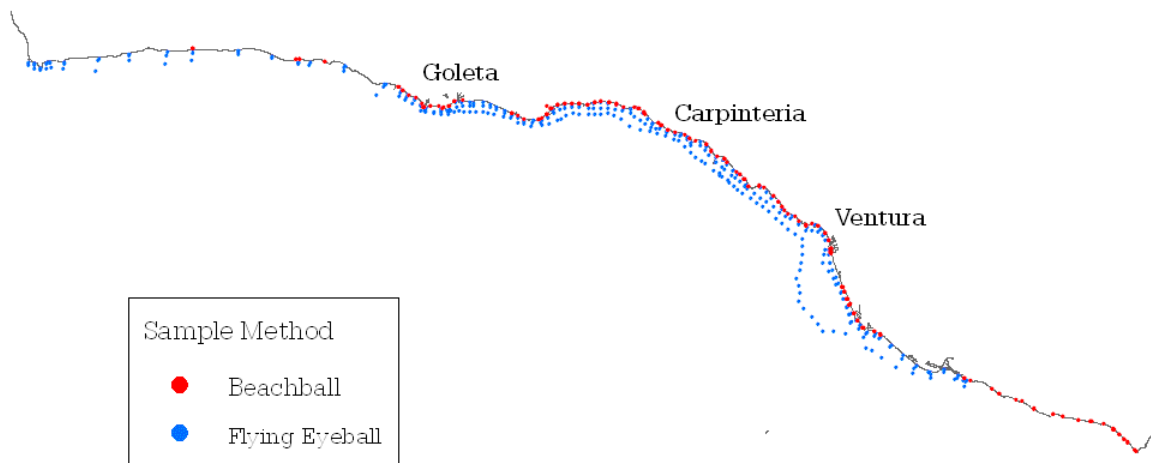


Figure 8. Sediment sample locations.



Figure 9. Flying eyeball operations aboard UCSB vessel, the R/V Connell.

Instrument packages containing current profilers were deployed offshore in 10 m water depth at each of the three focus areas in August 2006 (Figs. 10-11). After two months in the water, the instrument packages will be removed, and later redeployed over several months in the winter of 2006-7. The water levels, current profiles, and wave statistics extracted from these instruments will serve as numerical model calibration and validation points.

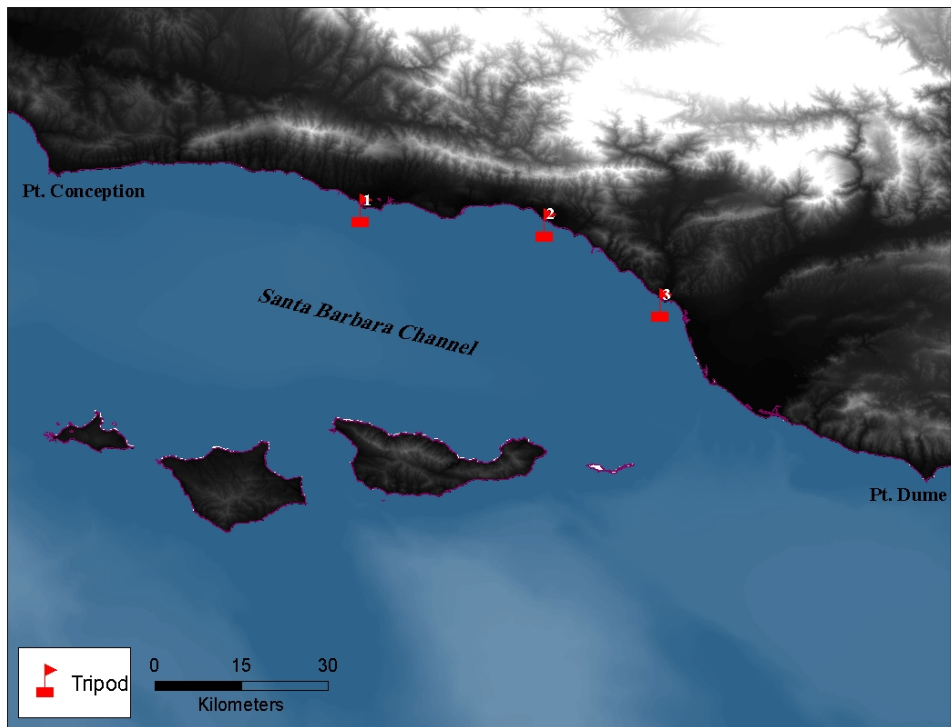


Figure 10. Instrument deployment locations.



Figure 11. Instrument package being prepared for deployment offshore of Carpinteria.

The Delft3D Community model, a regional hydrodynamic, wave and sediment transport model was set-up for Santa Barbara-Ventura County region, with high-resolution “nested” models designed for the local study areas (Figs. 12-14). The hydrodynamic boundary conditions were determined from local tide stations and a preliminary calibration was conducted using the Santa Barbara Harbor tide gauge. The SWAN (Simulating Waves Nearshore) wave model is forced using real time wind measurements and wave buoy data, including data from the existing CDIP buoys and roving Scripps wave buoy funded by BEACON. The models will require additional calibration and validation, provided by data from previous studies and the data obtained through field deployments in this study.

Ultimately, model results will contribute greatly to the estimation of sediment flux pathways and the calculation of a regional sediment budget by expanding discrete in-situ data collection to the entire region. We are working directly with Bill O’Reilly from Scripps to ensure that our instrument deployments are directly linked to the wave measurements the Scripps group will be making during the same time periods further offshore to maximize model calibration and validation.

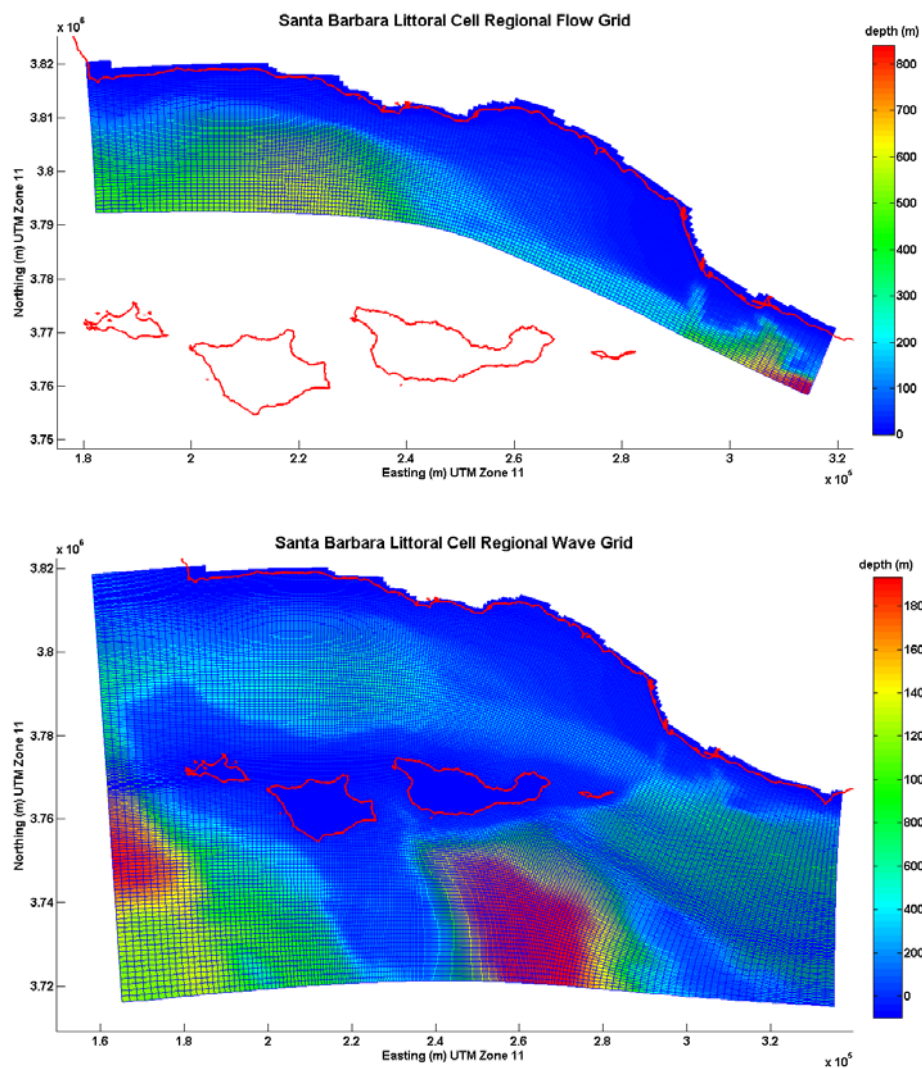


Figure 12. Regional Delft3D flow (top) and wave (bottom) model grids.

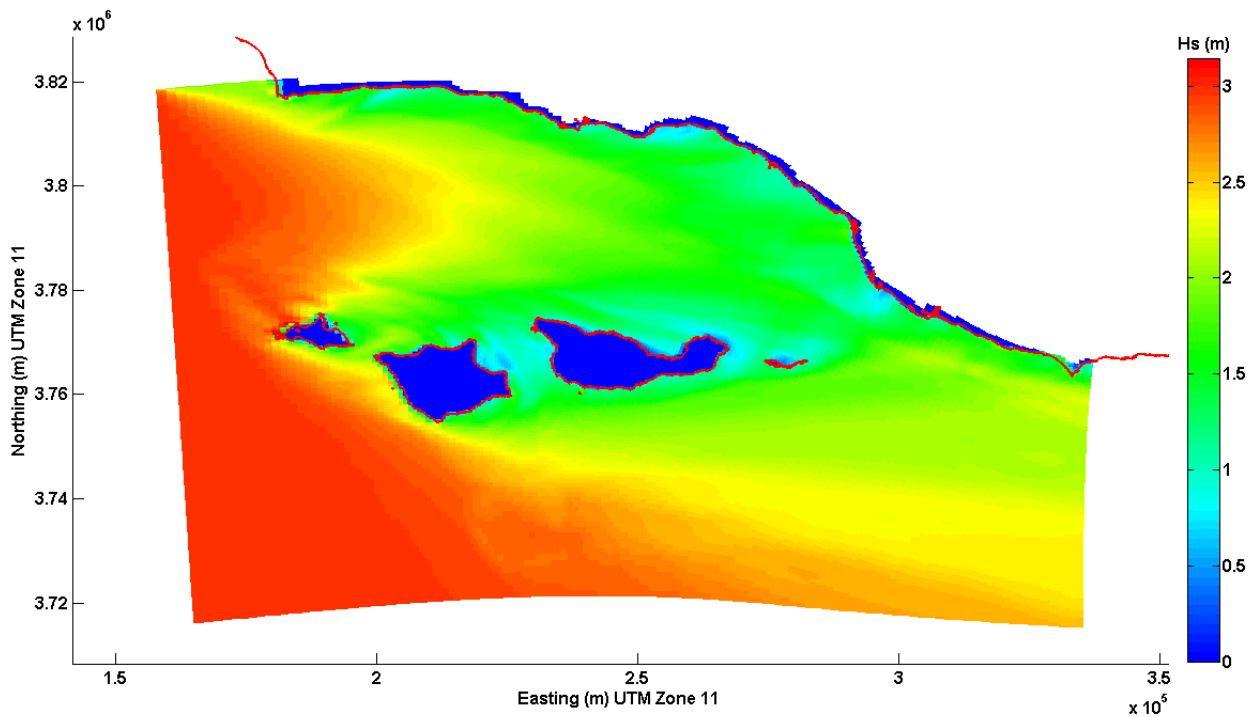


Figure 13. SWAN significant wave height map during a west swell ($H_s=3$ m, $T_p=15$ sec, direction= 270°).

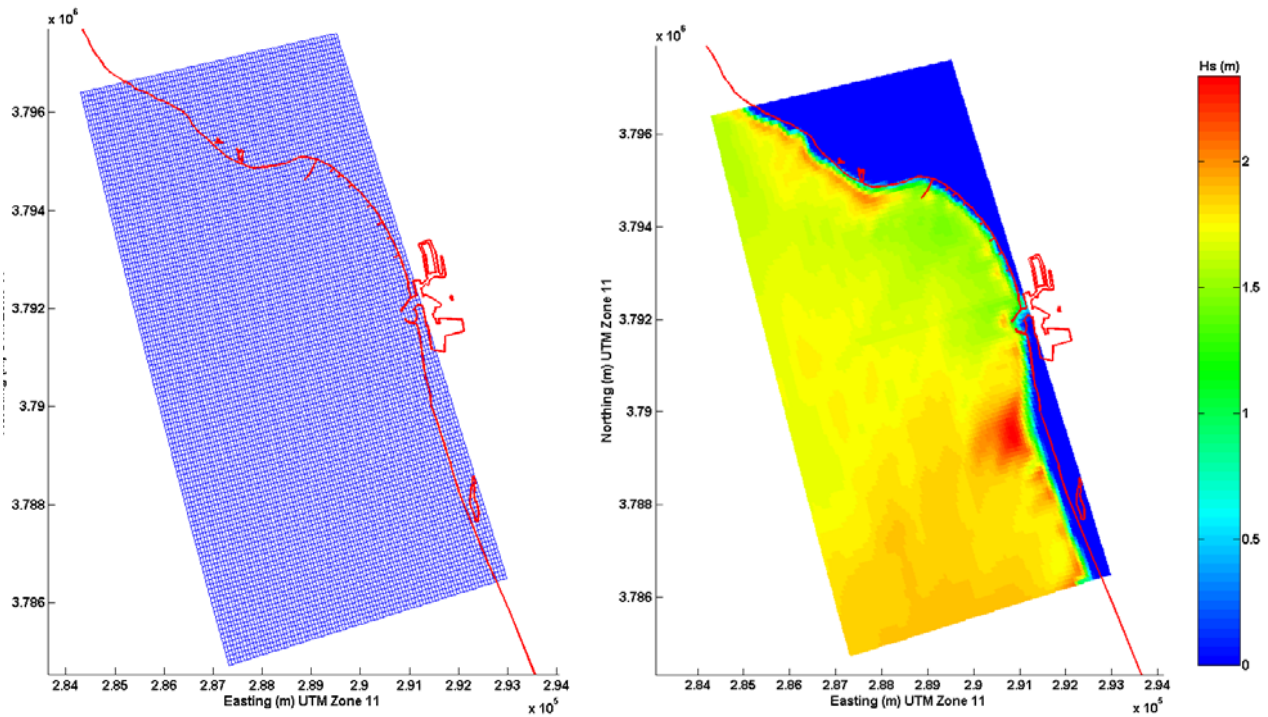


Figure 14. Examples of a nested, high resolution grid for the Ventura/Santa Clara River mouth area (left) and significant wave height patterns (right) predicted by SWAN during a south swell ($H_s=3$ m, $T_p=15$ sec, swell direction= 180°).

2d. Nearshore Wave Climatology Investigations

Data from the wave buoy deployments by UCSD as well as historic CDIP buoy data will be integrated into our numerical model to determine wave transformation patterns over the shelf in the study area, and the implications for cross-shore and longshore sediment transport. Special emphasis will be placed on the three focus study areas.

2e. Storm-Related Coastal Flooding Analysis

Using lidar from 1997, 1998 and 2005, a coastal vulnerability analysis will be performed for the entire region. Storm water levels can be predicted by Delft3D and wave-run-up calculations will be made using an array of run-up equations to predict profile overtopping and cliff toe erosion. Much of this work will be funded by the USGS Multihazards Initiative.

2f. Shoreline and Volumetric Change Evaluations

Work during FY 2006, has involved acquisition and rectification of historic imagery and digitizing of historic beaches (Fig. 15). Imagery has been rectified, and beach widths extracted along roughly 80 km of shoreline from Ellwood/Isla Vista to Ventura Harbor. Beach widths were adjusted based on tide level at time of photography.

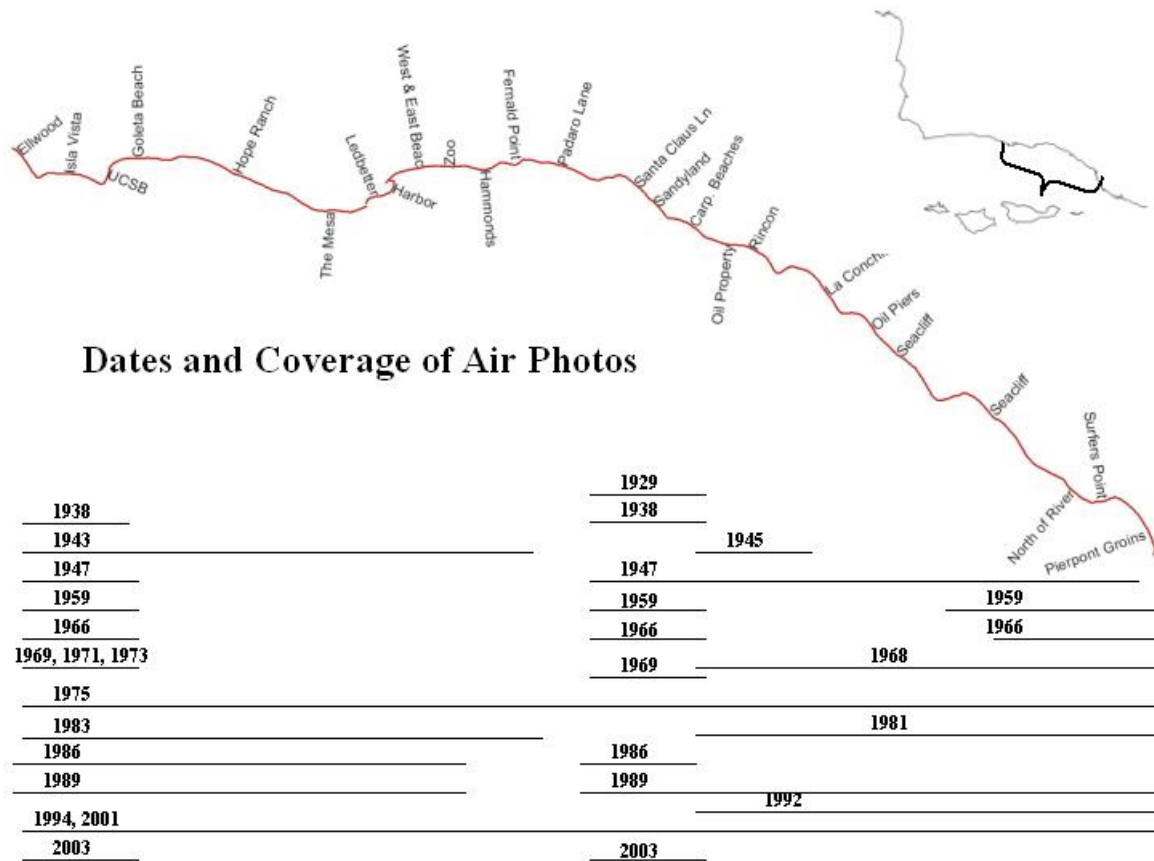


Figure 15. Air photo coverage between Goleta and Ventura.

Detailed findings for Isla Vista will be published following peer-review in Shore and Beach, October 2006, or available upon request. The overall beach width variability provides valuable information on beach stability, those locations where beach widths have a wide minimum beach width (Fig. 16). Figure 16 also shows locations of “storage beaches”, those with

narrow minimum beach widths (often zero) with wide variability that could have a capacity to store sand. The locations of these storage and stable beaches have significant implications to the BEACON monitoring program. By monitoring the stable beaches, we may better understand the reductions in sand supply while monitoring the “storage beaches” will provide information on upcoast accretion or erosion waves moving downdrift.

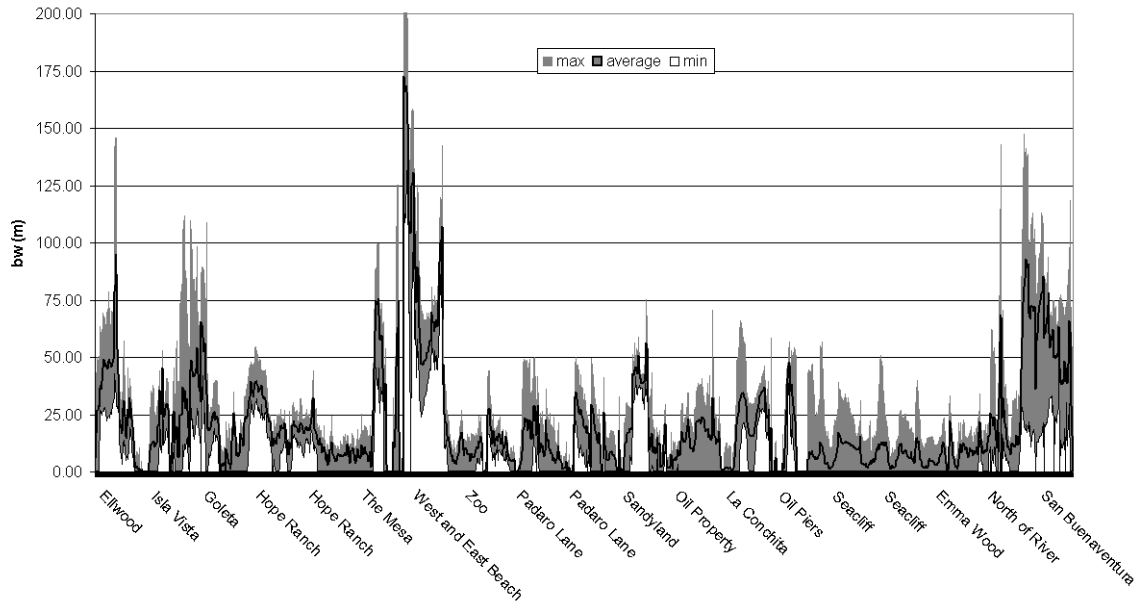


Figure 16. Historical beach width between Goleta and Ventura.

Focused studies on the 1997-98 El Niño along Isla Vista and Carpinteria using topographic LIDAR have related beach rotations to erosion hotspots. The persistence of these hot spots can largely explain the continued erosion at Goleta Beach following the El Niño event.

Future work in the upcoming year will include analyses on long-term shoreline change rates, beach width changes related to various types of shore protection, an additional El Niño focused study at Surfer’s Point, and volumes and mechanisms of sand transport along the beaches.

2g. Sediment Budget Analysis

All of the above will be integrated and analyzed to calculate a sandy sediment budget for the entire study area. Calculations of river input to the system will be gathered through our collaboration with Katie Farnsworth and Jon Warrick and ongoing investigations by Howard Chang. Historical alongshore transport rates and variability will be gathered from harbor dredging rates provided by our collaborators at UCSC.

Task 3. Geotechnical Studies

3a. Data Collection and Review

Data mining has been conducted to gather all data pertinent to the sediment transport characteristics of the study area. This has been supplemented greatly by the “eyeball”, multibeam, and grab sampling surveys, which are resulting in an unprecedented spatial coverage of sediment grain size throughout the study area.

3b. Geotechnical Seacliff Studies

Along with gathering data from previous studies, the eyeball camera will be used to determine grain size distribution in the seacliff exposures. Seacliff location, morphology, thickness and grain size distribution will be determined for the entire study area. Grain size distribution combined with rates of cliff retreat as determined from the recently completed USGS National Assessment will be used to estimate the volume of beach quality sand supplied to the study area.

Task 4. Products

Interim Progress Report (delivered end FY2006)

Final Report- summary of all work to BEACON and USACE (end 2007)

Map Series- bathymetry, grain size, bedforms, backscatter, beach elevation, beach change, shoreline change, nearshore change, wave, circulation and sediment transport modeling results (end 2007)

Santa Barbara/ Ventura GIS- GIS encompassing all pertinent past and present data collection (initiated at start of study)

USGS Open File Report- summary of all work to include data repository for all data collected in this study (end 2007)

Ph.D. Dissertation- David Revell- Historical Beach Change in the Santa Barbara Littoral Cell (Summer 2007)

Master's Thesis-Neomi Mustain- Grain Size Distribution in the Santa Barbara Littoral Cell (Summer 2007)

Journal Publications- TBD